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1321786

DRAWINGS ATTACHED

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(19)

(54) EXPLOSIVE CARTRIDGE

(71) We, CANADIAN INDUSTRIES LIMITED, of 630 Dorchester Boulevard West, Montreal, Province of Quebec, Canada, a Canadian Corporation, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to an explosive cartridge. The invention is especially advantageous for large diameter cartridges of explosive blasting agents containing large quantities of water soluble ingredients.

Explosive blasting agents based on oxygen-supplying salts such as, for example, ammonium nitrate, and sensitizers or fuel ingredients are widely known and used. These blasting explosives are not only efficient and powerful but are also economic to manufacture and use. Such blasting explosives, however, suffer from the disadvantage that they are susceptible to desensitization in the presence of water since the principal oxygen-supplying salt ingredient is water soluble. It is, therefore necessary to protect such blasting explosives from the damaging effect of water when they are used, for example, in wet boreholes.

It has heretofore been proposed to package water sensitive blasting explosives in sealed metal containers in order to provide protection against borehole water. It has also been proposed to employ protective shells or containers consisting of multiple wraps of water impervious paper, the containers being suitably end-sealed with wax or resin or metal closures. More recently it has been common to employ containers of thermoplastics material such as polyethylene. These polyethylene containers are normally made from thin-walled tubing, heat sealed at the base end and closed at the filling end by means of a wire tie or similar devices. Such explosive cartridges may then be placed in a borehole of appropriate diameter. Alternatively, a long sleeve of thin-walled thermoplastic tubing sealed at the bottom end may be placed in the borehole as a liner, the blasting explosive therealong being placed within the liner. While the use of thin-walled thermoplastics bags or tubing has generally eliminated the high cost of earlier proposed containers, these nonetheless suffer the disadvantage that they catch and tear on projecting points of rock on the walls of boreholes, thus destroying the water-proofing effect of the plastic and exposing the explosive contents to the dissolving action of water. Similarly, it is frequently difficult to ensure that the thin-walled plastics cartridges have fallen fully to the bottom or foot of the boreholes and subsequent tamping may perforate or otherwise damage the cartridges.

These latter problems have been overcome by the use of the explosive cartridge disclosed by G. Towell and G. R. Phare in Canadian Patent No. 794,623 issued on September 17, 1968, which cartridge comprises a blasting explosive in a heat-sealed water-impervious thermoplastics bag, the bag being disposed within a protective outer rigid paper shell and the shell being crimp-closed at one end in a bullet-nosed shape.

The explosive cartridge of the above Canadian Patent is, however, not without some disadvantages. These are related to a reduced cartridge-to-cartridge propagation during the detonation of a charge when a series of cartridges are placed end-to-end in a borehole. This tendency towards reduced cartridge-to-cartridge propagation is mainly attributed to the collection of paper at the closed end of the outer paper shell when the bullet-nosed crimp closure is made. The amount of folded paper which is required to provide a suitably strong crimp closure, that is, one which will not open inadvertently and release or expose the internal plastics bag of explosives, is sufficient under some conditions to interrupt or slow down the detonation wave along a train of cartridges.

It is therefore an object of this invention to provide a low cost, water impervious blasting cartridge of improved cartridge-to-cartridge propagation sensitivity.

Other objects of the invention will become apparent hereinafter.

The improved blasting explosive cartridge of the invention comprises a substantially rigid tubular paper shell open at both ends, a thin-walled water-impervious thermoplastics bag disposed in tight non-slipping relationship within said shell and a blasting explosive composition contained within said bag, said bag being sealed at both ends and having an unfilled portion projecting outward beyond one open end of said shell, the opposite open end of said shell having a thermoplastics cap in closely fitting enclosing relationship thereover. Preferably the open end of the paper shell having the thermoplastics cup thereover has a tapered shoulder configuration.

The invention may be more fully understood by reference to the accompanying drawing wherein

Figure 1 shows a view of the cartridge in accordance with the present invention and

Figure 2 shows a partly cut-away sectional view of the same cartridge.

Referring in detail to the Figures of the drawing, there is shown a spiral-wound paper shell 1 having open ends 2 and 3. Open end 2, shown as the lower end in the Figures is preferably partly folded inward upon itself to provide a bullet-nose shape or taper. This shape facilitates the loading of the cartridge into boreholes. A thin-walled thermoplastics bag 4 having a diameter only slightly larger than the internal diameter of shell 1 is disposed within shell 1. Bag 4 is, at its lower end, closed to form a bag by means of a fused heat seal (not shown). An extension of bag 4, indicated as 7 projects beyond the upper open end 3 of shell 1. Water-sensitive, blasting explosive 8 fills bag 4 to a point just below the level of open end 3 of shell 1. Heat seal 5, is made across bag 4 to provide a water-impervious bag for blasting explosive 8. Additionally, if desired, a wire tie 6 may be used to bunch together tube extension 7, into a carrying means. A thin-walled thermoplastics cap 9 is shown over open lower shell end 2 and heat-shrunk in place to provide a seal against the ingress of moisture and to assist in retaining bag 4 within shell 1. In addition, cap 9 prevents the flaring open of any folds in the lower shell end when a tapered shoulder construction is employed.

A conventional spiral-winding machine may be used to prepare outer shell 1, the bullet-nose taper at one end being made, if desired, by wall known means. No special waterproofed paper or glue need be employed in preparing shell 1 since the cartridge does not rely on the composition of the shell for its water-proofness. The shell, however, may be wav-coated to protect it from moisture prior to loading into a borehole. The material comprising thermoplastics bag 4 is preferably polyethylene but any thin-walled flexible thermoplastics material suitable for heat sealing may be used. The end-closing cap 9 can be made of any heat-sealable and heat-shrinkable thermoplastics, e.g. thermoplastics film or tubing, and preferably is made of polyethylene. Generally cap 9 has a wall thickness in excesss of 0.003 inch and its diameter is slightly greater than the internal diameter of shell 1. Preferably the shape of cap 9 should conform to that of the lower end of the shell at open end 2. Cap 9 may also be made by known thermoforming techniques.

In the manufacture of the cartridge of the invention, shell 1 is prepared by spiral-winding methods and is preferably partly closed at end 2 by forming the tube end into a bullet-nose shape. Plastics sock or cap 9 is pulled over open end 2 of shell 1 and this assembly is subjected to a heat treatment for a short period under conditions which shrink cap 9 to produce a tightly clinging fit to the end of shell 1. Where cap 9 is made of polyethylene of from 0.006 to 0.008 inch thickness, this treatment consists of exposure to temperatures of from about 450°F. to about 500°F. for a period of about 10 to 15 seconds. The capped shells may, for example, be passed through a heated chamber or tunnel or may be subjected to a stream of heated air to achieve the desired shrinkage of cap 9. Where a preformed cap 9 is used, this is pulled over open end 2 of shell 1 and secured thereto by means of a suitable adhesive. Thin-walled bag 4, preferably closed by a heat-seal at one end, is placed within shell 1 so that the heat-sealed end lies at the base or lower end of shell 1. The length of bag 4 is selected so that an extending portion 7 projects beyond the open end 3 of shell 1. The diameter of bag 4 is ideally slightly larger than the inner diameter of shell 1. Blasting explosive 8 is placed in bag 4 and the tube is filled to a point slightly below or even with the level of open shell end 3. After filling the extended portion 7 of bag 4 is heat-sealed in an area 5 close to the open end 3 of shell 1. If desired, the extended portion 7 of bag 4 may be bunched by means of a wire tie 6 to provide a carrying means or a loop for a lowering line hook. Alternatively, a handle taped to the upper end of shell 1 may be provided for carrying and lowering purposes.

In use in the field the cartridge may be carried by grasping the extended bag portion 7 since a non-slipping contact is provided between filled, bag 4 and the inner wall of shell 1. The cartridge may be dropped or lowered by line, for example, into a vertical borehole, the taper at the bottom end 2 facilitating easy descent and shell 1 providing abrasion protection for bag 4. Where cartridges are placed end-to-end in a borehole to form an explosive train, the absence of any gathering of paper at either

end of the cartridges permits intimate contact and provides an uninterrupted propagation of the explosive train at full velocity.

In laboratory testing it was observed that cartridges of the invention when subjected to 11 psi hydrostatic pressure for 48 hours showed no evidence of leakage. In gap unconfined sensitivity tests a 4 inch diameter cartridge of the invention containing an ammonium nitrate/fuel explosive and detonated at a V.O.D. of 3800 meters/sec. propagated a second similar cartridge at a V.O.D. of 3800 meters/sec. across a 2 inch air gap. A V.O.D. of 3100 meters/sec. was achieved in the receptor cartridge when the gap was 3 inches. In the field, two filled cartridges of 5 1/2 inch diameter and 22 1/2 lbs. weight attached to a cord were allowed to drop freely for 70 feet down a borehole. Upon retrieval, no signs of damage to the cartridge were noted.

As mentioned heretofore, the outer shell of the cartridge of the invention is preferably of the spiral wound type and made of from 3 to 7 plies of paper having a thickness of from 0.004 to 0.012 inch. Similarly the material of the inner bag of the cartridge is preferably one or two layers of polyethylene of a thickness of from about 0.002 to 0.004 inch. It is especially preferred that the inner bag comprises a double wall bag since, two plies of plastic provide greater impact abrasion and tear resistance than does a single ply of the same overall thickness. In this preferred embodiment, either both plies or only the innermost ply may be heat-sealed.

The cartridges of the invention are normally of the large diameter long length type, that is cartridges having a diameter of 2 to 9 inches and a length of from 20 to 36 inches.

While the cartridge of the invention is particularly useful with blasting agents susceptible to water desenitization, this is not to say that its use is limited to such compositions. However, explosives subject to ignition or detonation in the presence of the temperatures required to effect heat-sealing of the inner plastic tube would obviously not be employed in cartridges where bag 4 is to be heat sealed after filling.

WHAT WE CLAIM IS:—

1. A blasting explosive cartridge comprising a substantially rigid tubular paper shell open at both ends, a thin-walled water-impervious thermoplastics bag disposed in tight non-slipping relationship within said shell and a blasting explosive composition contained within said bag, said bag being sealed at both ends and having an unfilled portion projecting outward beyond one open end of said shell, the opposite open end of said shell having a thermoplastics cap in closely fitting enclosing relationship thereover.

2. A cartridge as claimed in Claim 1 wherein the bag has two plies and only the inner ply is heat-sealed at both ends.

3. A cartridge as claimed in Claim 1 wherein the bag has two plies which are both heat-sealed at both ends.

4. A cartridge as claimed in Claim 1 wherein the unfilled projecting portion of the bag is bunched by means of a wire tie.

5. A cartridge as claimed in any one of Claims 1 to 4 wherein the thermoplastics cap is made of heat-shrunk thermoplastics film.

6. A cartridge as claimed in any one of Claims 1 to 5 wherein the thermoplastics cap is a preformed cap.

7. A cartridge as claimed in any one of Claims 1 to 6 wherein the wall of the paper shell at the end which is provided with the cap is tapered.

8. A blasting cartridge substantially as herein described and shown in the accompanying drawings.

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Agent for the Applicants.

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1321786 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

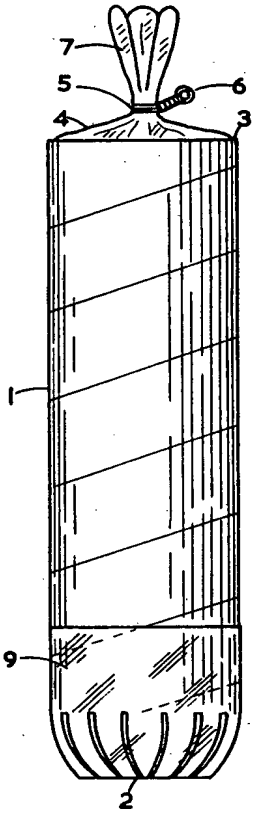

FIG. 1

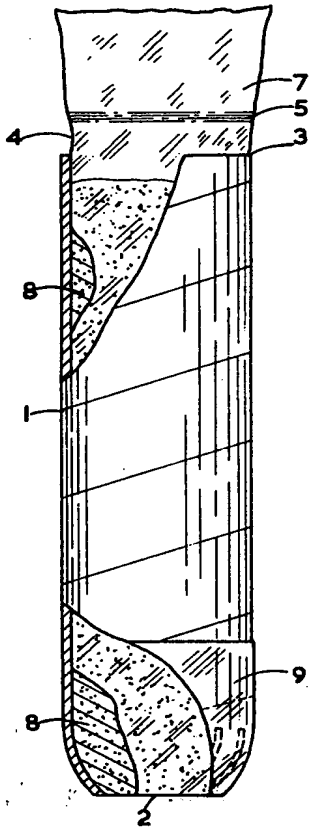

FIG. 2